

TAXONOMIC REVIEW OF THE GENUS *GROUVELLINUS* CHAMPION
(COLEOPTERA: ELMIDAE) FROM TAIWAN AND JAPAN

MING-LUEN JENG AND PING-SHIH YANG

Laboratory of Insect Conservation, Department of Entomology, National Taiwan University, Taipei, Taiwan 106, Republic of China (e-mail: chener38@mz.dj.net.tw).

Abstract:—The species of *Grouvellinus* from Taiwan and Japan are reviewed. Seven species and one subspecies, *G. pilosus*, n. sp., *G. montanus*, n. sp., *G. hygroptericus*, n. sp., and *G. babai babai* Nomura from Taiwan, and *G. marginatus* (Kôno), *G. nitidus* Nomura, *G. subopacus* Nomura and *G. babai satoi*, n. ssp. from Japan, are described or redescribed. Male genitalia of all species are depicted. A lectotype for *G. marginatus* is designated.

Key Words: Elmidae, *Grouvellinus*, review, new species, new subspecies, Taiwan, Japan

The generic name *Grouvellinus* was proposed by Champion (1923) as a replacement name for the homonyms *Microdes* Motschulsky (1859) and *Grouvelleus* Zaitzev (1908). The genus is widely distributed in the Oriental and Palaearctic regions (Brown 1981, Jäch 1984, Jäch and Kodada 1995), and 31 species are known so far.

Until now, three species of *Grouvellinus* were known from Japan (*G. marginatus* (Kôno), *G. subopacus* Nomura and *G. nitidus* Nomura), and one was described from Taiwan (*G. babai* Nomura). Nomura (1963) published a key to the Japanese and Taiwanese species of *Grouvellinus*. However, the identification of these species has remained somewhat ambiguous. In this paper we review the previously described species and describe three new species and a new subspecies. In addition, we also provide a revised key which contains more reliable characters.

MATERIAL AND METHODS

Descriptions are mainly based on alcoholic material and SEM micrographs. Body length (BL) is the sum of pronotal and ely-

tral lengths (PL + EL); body width (BW = EW) means the broadest width of elytra. The first stria interval of elytra means the sutural interval (in contrast to Nomura (1962, 1963) who regarded the space between the first two striae as the first interval). The scale bar in illustrations represents 0.1 mm unless indicated otherwise. Descriptions and illustrations of spines in the ejaculatory duct are omitted. Except the data of holotypes, the collector is omitted in collecting data if the specimen(s) was sampled by the senior author.

To facilitate SEM observation, the mud-coated specimens are treated with hydrochloric acid (HCl) for 1 minute and then soaked in water for about 30 seconds; the specimens are then transferred to a small vial containing water, and then placed in an ultrasonic cleaning device for about 2 minutes. SEM micrographs are made with a Hitachi S-2400 at 20KV.

ACRONYMS

CSUS —Department of Biological Science,
California State University, Sac-

- ramento, U. S. A. (Dr. W. D. Shepard)
- DEI –Deutsches Entomologisches Institut, Eberswalde, Germany (Dr. L. Zerche)
- NMNS –National Museum of Natural Science, Taichung, Taiwan (Ms. M.-L. Chan)
- NMW –Naturhistorisches Museum Wien, Austria (Dr. M. A. Jäch)
- NSMT –National Science Museum (Natural History), Tokyo, Japan
- NTU –Department of Entomology, National Taiwan University, Taipei, Taiwan (M.-L. Jeng)
- NWU –Nagoya Women’s University, Nagoya, Japan (Dr. M. Satô)
- OMNH –Oklahoma Museum of Natural History, University of Oklahoma, Norman, U.S.A. (Dr. H. P. Brown)
- TARI –Department of Applied Zoology, Taiwan Agricultural Research Institution, Taichung, Taiwan (Dr. L.-Y. Chou)

TAXONOMY

KEY TO THE SPECIES AND SUBSPECIES OF *GROUVELLINUS* FROM TAIWAN AND JAPAN

- 1. Prosternal process less than 1/3 as wide as pronotum (Figs. 30–36); elytral striae deeply notched (Fig. 20); each ventrite with surface granulate (Fig. 40) 2
- Prosternal process subquadrate, broad, about 1/2 as wide as pronotum (Fig. 29); elytral striae not deeply notched (Fig. 19); only last ventrite granulate and the rest punctate (Fig. 39); Taiwan *G. pilosus*, n. sp.
- 2. Body elongately obovate (Fig. 28), with BL/BW about 2.1–2.4 (elytra with EL/EW about 1.5–1.7) 3
- Body obovate and stout (Fig. 27), with BL/BW about 2.0 (EL/EW about 1.3–1.4); Amami and Okinawa Islands *G. subopacus* Nomura
- 3. Male genitalia from 400–700 µm in length; body length not longer than 2.3 mm in male and 2.5 mm in female 4
- Male genitalia about 750–800 µm long; body size large, 2.3–2.6 mm in male and 2.5–2.7 mm in female; Taiwan *G. hygropticus*, n. sp.
- 4. Pronotal disc smooth and shining (Figs. 3–4, 11) 5

- Pronotal disc scabrous, shagreen-like or densely punctate (Figs. 7–9) 6
- 5. Pronotum more or less strongly convex (Fig. 46B); surface of sublateral gibbosity of pronotum smooth, with only a few superficial punctures (Fig. 11, GB); Japan
- *G. nitidus* Nomura
- Pronotum evenly convex (Fig. 46A); surface of pronotal gibbosity scabrous or densely granulate (Figs. 3–4); Taiwan
- *G. montanus*, n. sp.
- 6. Male genitalia larger (ca. 500 µm); paramere elongate and slender, about 1.9 times as long as basal piece (Fig. 52); Japan
- *G. marginatus* (Kôno)
- Male genitalia smaller (ca. 400–440 µm); paramere shorter, about 1.4 times as long as basal piece (Figs. 50–51) *G. babai* Nomura 7
- 7. Body 1.9–2.2 mm in length; pronotum with surface shagreened; abdomen very densely granulate on all ventrites (Fig. 41); Taiwan
- *G. babai babai* Nomura
- Body 1.6–1.8 mm in length; pronotum with surface densely punctate; first abdominal ventrite with fewer granules on disc than those on other ventrites (Fig. 42); Yaeyama Islands
- *G. babai satoi*, n. ssp.

***Grouvellinus pilosus* Jeng and Yang, new species**

(Figs. 1, 2, 12, 19, 29, 37, 39, 47)

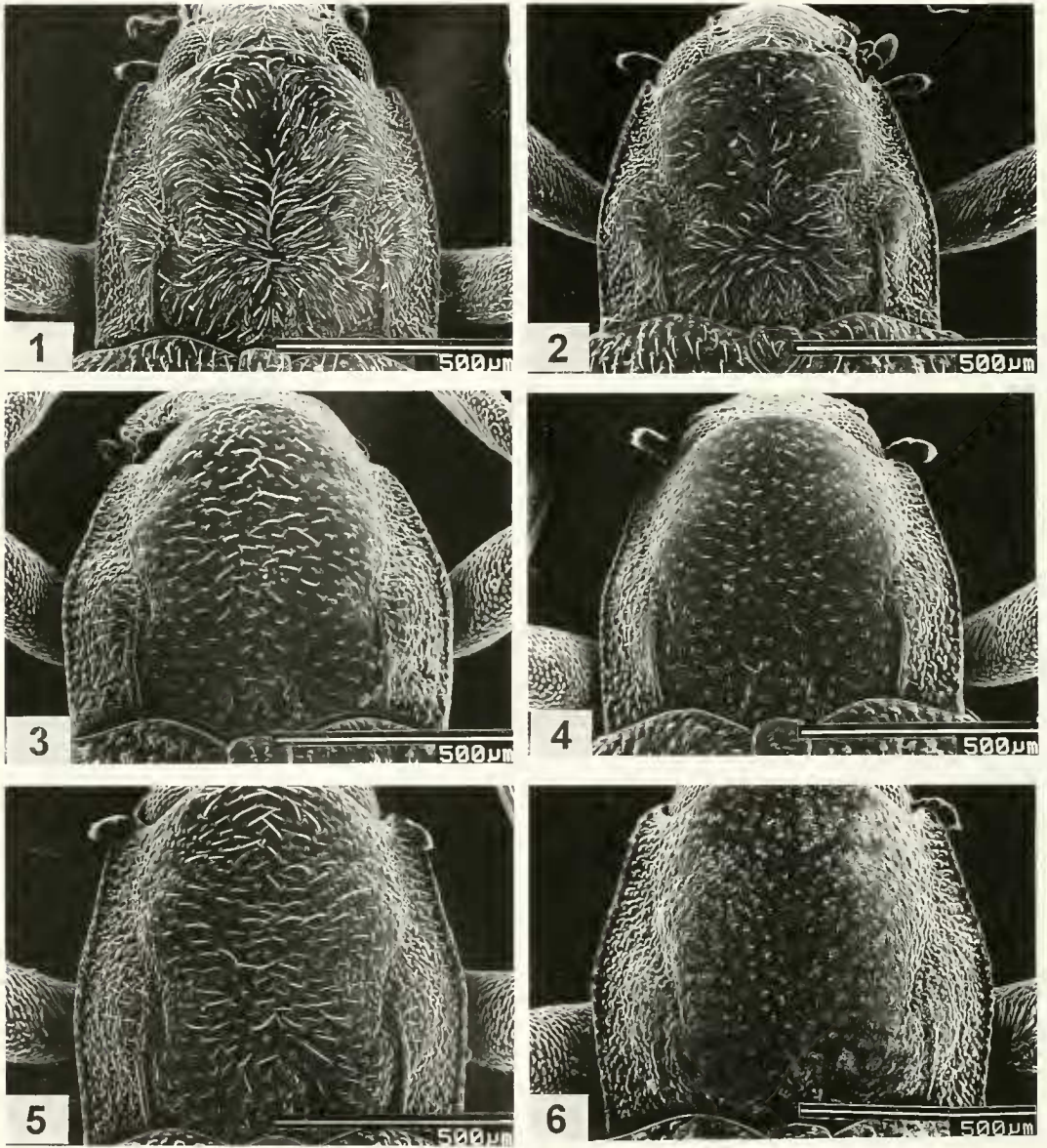
Type locality.—Neishuangshi, Shihlin, Taipei City, northern Taiwan.

Description.—BL: 1.8–2.1 mm (male), 2.0–2.2 mm (female); BW: 0.9–1.0 mm (both sexes).

Body shape elongate obovate, subparallel. Dorsum brown, shining, with bronze lustre; elytra sometimes paler than pronotum. Venter brown to dark brown, weakly lustrous. Legs brown. Antenna, mouthparts and tarsi yellowish brown.

Head with surface smooth, sparsely and superficially punctate. Frons with 3 or more longitudinal rows of pubescence. Clypeus with lateral sides broadly rounded; pubescence on disc denser than on frons. Labrum smooth, pubescent only laterally, and very finely punctate apically.

Pronotum (Figs. 1–2) evenly convex, 1.3 times as broad as long; broadest at basal 2/5; surface (Fig. 12) weakly scabrous, accompanied with dense and superficial punc-

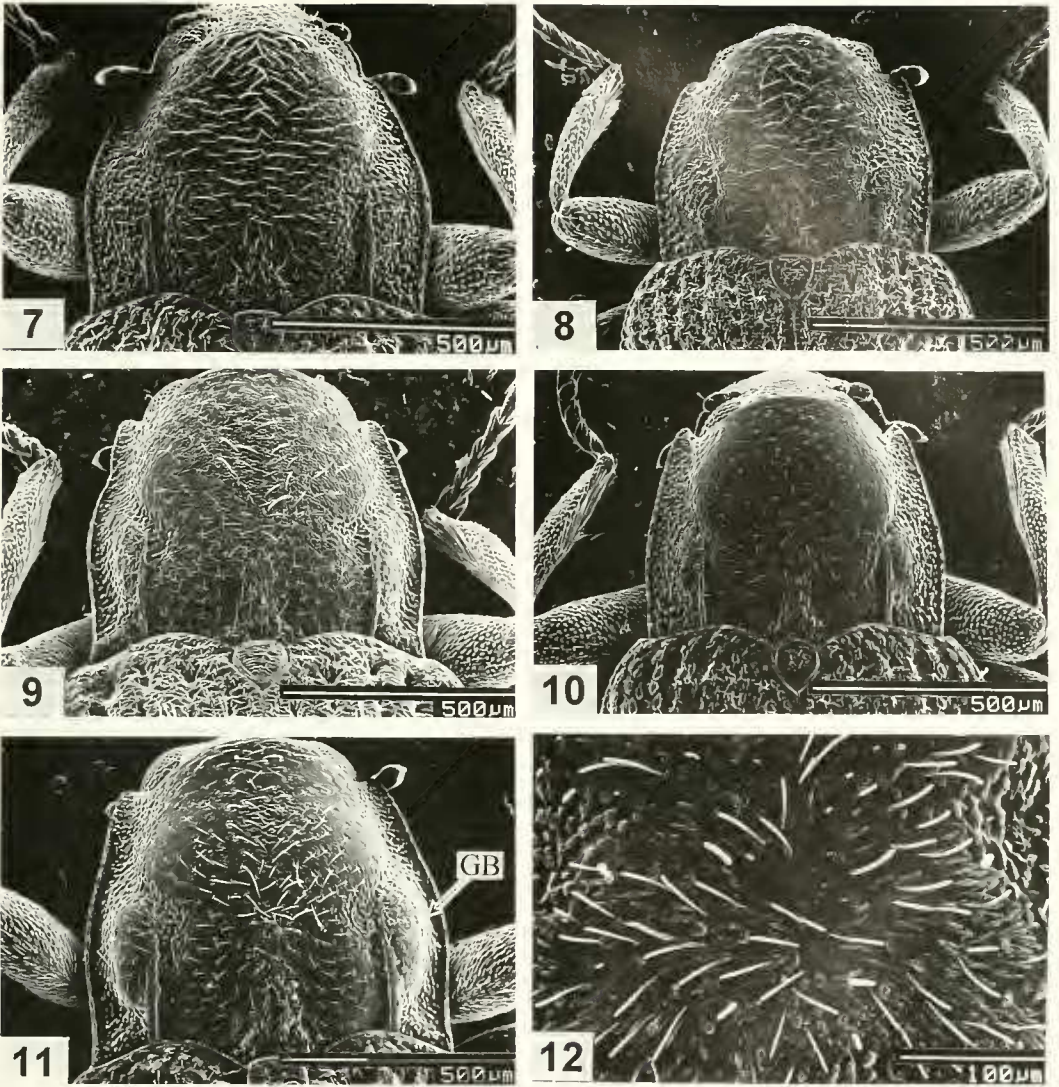


Figs. 1-6. Pronotum. 1, 2, *Grouvellinus pilosus*. 3, 4, *G. montanus*. 5, 6, *G. hydropetricus*.

tures, and densely covered with long, adpressed, decumbent pubescence. Sublateral carinae subparallel, extending from base to basal $\frac{2}{5}$; an oblique impression on each side extending from apical end of carina to near anterior angle. Base with two elongate oval impressions in front of anterior angles of scutellum.

Elytra (Fig. 19) 1.3 times as broad as

pronotum, 1.5-1.6 times as long as broad, with conspicuous sexual dimorphism (elytral apex more acute in female but conjointly rounded in male). Sides subparallel in basal $\frac{2}{3}$ and thence tapering arcuately to conjoint apex. Strial punctures in basal half deep and large, subcircular, separated from each other by 1 to 2 times their diameters; punctures becoming smaller and more



Figs. 7–12. Pronotum. 7, *Grouvellinus babai babai*. 8, *G. babai satoi*. 9, *G. marginatus*. 10, *G. subopacus*. 11, *G. nitidus*. 12, *G. pilosus*, central disc of pronotum. GB = sublateral gibbosity of pronotum.

widely separated (about 2–3 their diameters) in apical half. Strial intervals flat, minutely punctate and densely pubescent; interval 2 broad, about 2–3 times as broad as the diameter of basal punctures; intervals 3 and 4 about 1–1.5 times as wide as puncture diameter; interval 3 broadly and weakly convex at base; interval 7 with a row of weak granules.

Prosternal process (Fig. 29) about $\frac{1}{3}$ as wide as pronotum, subquadrate, strongly

rimmed, with a transverse, smooth elevation at base. Metasternum (Fig. 37) coarsely punctate; female with disc narrowly depressed along the median suture, and male with disc broadly impressed. Abdomen (Fig. 39) with the ventrites I–II deeply and coarsely punctate on disc; ventrites III–IV sparsely and minutely punctate; ventrite V granulate throughout.

Male genitalia (Fig. 47) long and slender, about 580 μm in length; penis surpassing

parameres, distinctly narrowed at basal $\frac{1}{5}$, broadest at basal $\frac{2}{5}$ and thence tapering toward apex. Ventral sac with lateral sides weakly sclerotized. Paramere slender and subparallel at apical half, with apex slightly dilated.

Variation.—The density of pronotal pubescence is variable, possibly due to age and detrition (Figs. 1, 2).

Type series.—Holotype ♂ (NMNS): "TAIWAN: Taipei city, Shihlin: Neishuangshi, 30.IV.1987, Wong K. C. leg." Paratypes (CSUS, DEI, NMW, NTU, OMNH, NWU): 2 ♀, same data as for holotype; 1 ♂ and 4 ♀, same locality, 25.VII.1986, Wong K. C. leg.; 2 ♀, same locality, 28.VIII.1986, Wong K. C. leg.; 2 ♂ and 6 ♀, same locality, 25.IX.1986, Wong K. C. leg.; 1 ♀, same locality, 18.X.1985, Wong K. C. leg.; 1 ♂, same locality, 28.V.1987, Wong K. C. leg.; 2 ♂ and 10 ♀, same locality, 20.VI.1987, Wong K. C. leg.; 2 ♀, same locality, 30.VII.1987, Wong K. C. leg.; 1 ♀, same locality, 27.VIII.1987, Wong K. C. leg.; 1 ♀, Taipei County, Pinglin: Daiyukushi, 31.VIII.1987, Wong K. C. leg.; 1 ♀, same locality, 21.VI.1988, Wong K. C. leg.; 1 ♂, same locality, 7.VII.1989, Wong K. C. leg.; 1 ♂ and 3 ♀, Taipei County, Pinglin: Beishihshi, 21.VI.1988, Wong K. C. leg.; 1 ♂ and 1 ♀, Taipei County, Tongho, XI.1989, Wong K. C. leg.; 2 ♀, Taipei County, Wanli: Malienshi, 13.VIII.1990; 2 ♂ and 3 ♀, Taipei County, Sanshah: Yomushi, 16.VIII.1990; 2 ♀, Taipei County, Jingmeishi: Shuangshiko, 30.IV.1993, Lee C. F. leg.; 1 ♀, Taipei County, Wulai: Tonghoshi, 9.IX.1993; 1 ♀, Taipei County, Shinshen: Nanshihshi, 10.IX.1993.

Additional material examined.—3, "Anko/TAIHOKU/ FORMOSA/ 20.iv.1941/ COL. S. MIYAMOTO"; 4, "Seitan, Sinten/ TAIHOKU/ FORMOSA/ 11.v.1941/ COL. S. MIYAMOTO"; 8, "Anko/ TAIHOKU/ FORMOSA/ 25.v.1941/ COL. S. MIYAMOTO"; 1, "Anko/ Taihoko/ vi.1941/ S. Miyamoto" (TARI), 6 ♂ and 11 ♀, Taipei County, Sanji: Balienshi, 25.VII.1990 (NTU).

Two specimens labeled "Seitan, Sinten/ TAIHOKU/ FORMOSA/ 11.v.1941/ COL. S. MIYAMOTO" (TARI) were designated as "cotypes" of "*Hapgroelmis formosanus*" by Y. Miwa during 1941–45. However this name was never published.

Differential diagnosis.—This new species is characterized by its long and dense pubescence on the dorsal surface, indistinct carina on 7th stria interval of elytra, subquadrate prosternal process, punctation on metasternum and abdominal ventrites, and characteristic male genitalia. It is somewhat difficult to group this new species with the other congeneric members as a subgroup. It can be separated from all the other species from Taiwan and Japan by the key provided above. *G. pelacoti* Delève from Vietnam also possesses long pubescent pattern, but its male genitalia are larger and more robust than those of *G. pilosus*, and its parameres taper uniformly toward their apices.

Distribution.—Known only from northern Taiwan. All localities are below 500 m. Most of the specimens were collected from creeks or streams with clear water and only few individuals were found in slightly polluted streams.

Etymology.—The specific name *pilosus* (Latin, hairy) refers to the long dorsal pubescence.

***Grouvellinus montanus* Jeng and Yang,
new species**

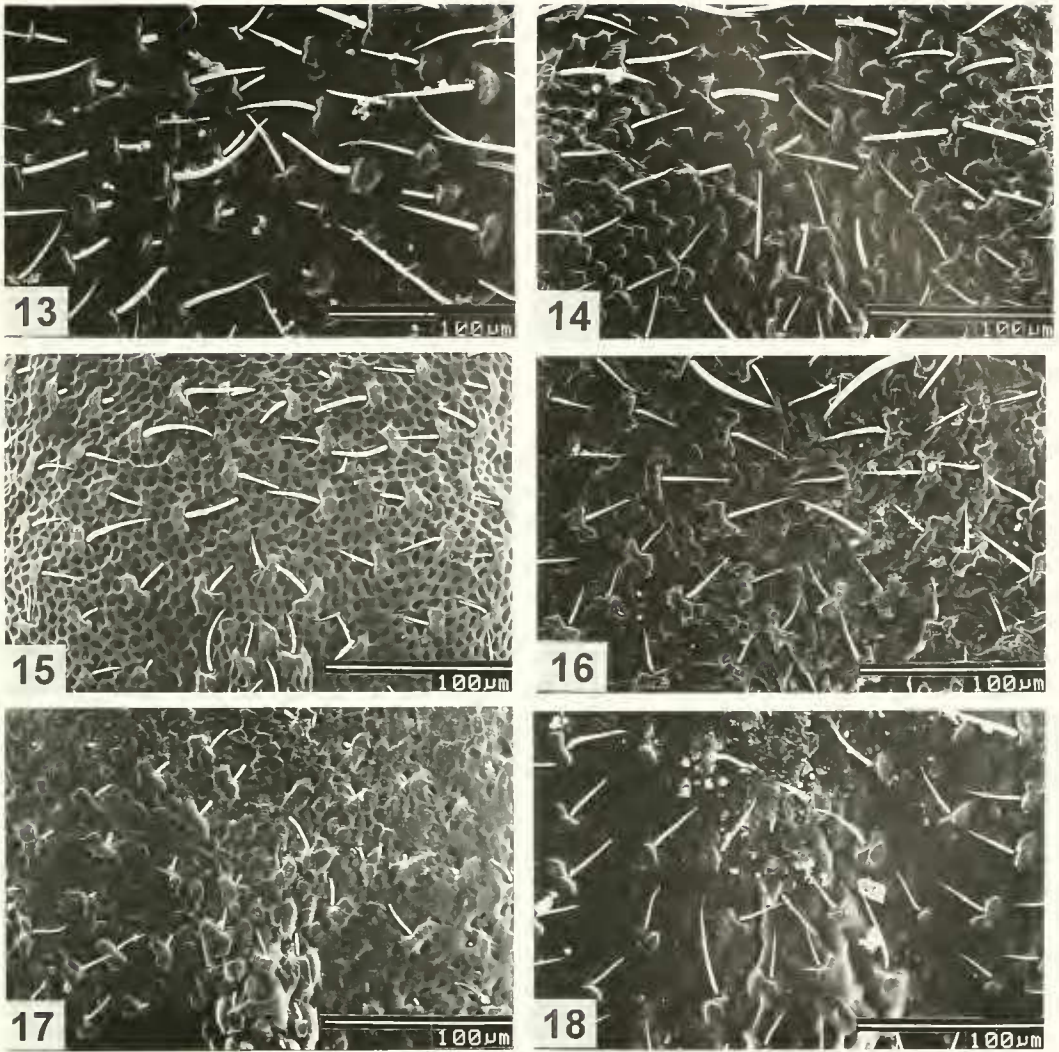
(Figs. 3, 4, 20, 30, 46A, 48)

Type locality.—A branch of San-Guang Stream, near Chiduan, Ilan County, north-eastern Taiwan.

Description.—BL: 2.0–2.3 mm (male), 2.3–2.5 mm (female); BW: 0.9–1.0 mm (male), 1.0–1.1 mm (female).

Body shape elongate obovate, subparallel. Dorsal surface dark brown to black, with strong bronze lustre. Venter brown and opaque. All femora and tibiae dark reddish brown. Antenna, mouthparts and tarsi yellowish brown.

Head with frons weakly coriaceous,

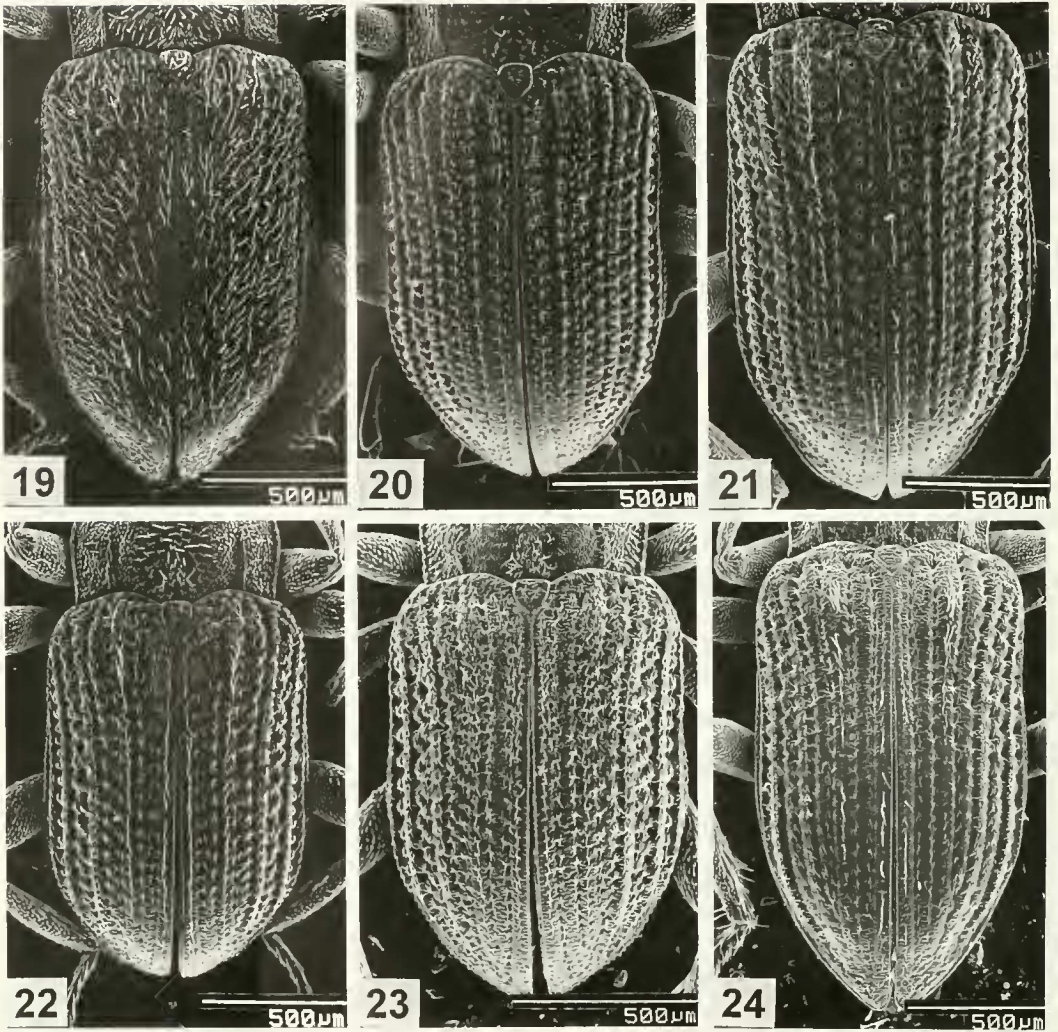


Figs. 13–18. Central disc of pronotum. 13, *Grouvellinus hydropetricus*. 14, *G. babai babai*. 15, *G. babai satoi*. 16, *G. marginatus*. 17, *G. subopacus*. 18, *G. nitidus*.

somewhat densely granulate, covered with sparse and indistinctly patterned pubescence. Clypeus with surface similar to that of frons, and coarsely punctate at sides. Labrum smooth, weakly punctate and densely pubescent laterally.

Pronotum (Figs. 3–4) 1.1 times broader than long, broadest at basal 2/5 or subparallel from there to basal angles; surface smooth, sparsely punctate in apical half of disc; granulation on disc variable among populations; distinct granulation pattern (Fig. 3, from type

locality) accompanied by a slightly scabrous surface, especially pronounced at base of the disc; weak granulation pattern (Fig. 4, from Mt. Taiping) appears on smooth pronotal surface, and each granule with a small adjacent pit making it look like a puncture rather than a granule. Sublateral gibbosity roughly granulate. Sublateral carinae present and each with an oblique impression from apex of carina to near anterior angle. Base with two elongate oval or round impressions in front of scutellum.



Figs. 19-24. Elytra. 19, *Grouvellinus pilosus*, female. 20, *G. montanus*, male. 21, *G. hygropetricus*, female. 22, *G. babai babai*, male. 23, *G. babai satoi*, male. 24, *G. marginatus*, female.

Elytra (Fig. 20) 1.3 times as broad as pronotum, and about 1.6 times as long as broad, with conspicuous sexual dimorphism (elytral apex more acute in female but conjointly rounded in male); sides subparallel at apical $\frac{1}{3}$ and thence tapering arcuately to conjoint apex. Striae deeply notched, strial punctures on disc quite large, subcircular, separated longitudinally from each other by $\frac{1}{3}$ or $\frac{1}{2}$ their diameters. Strial intervals moderately convex, but first two intervals usually flat in aged adults; surface transversely rugose, each interval with one or two rows

of superficial granules and pubescence; interval 3 broadly and weakly elevated at base where it bears an indistinct tuft of pubescence; intervals 5, 7, 8 carinate.

Prosternum (Fig. 30) with prosternal process subparallel sided, moderately broad, a little broader than $\frac{1}{4}$ of pronotal width, with apex broadly rounded. Metasternum strongly coriaceous, coarsely granulate; disc concave along sulcus in female and broadly depressed in posterior half area in male. All abdominal ventrites with discs granulate throughout.

Male genitalia (Fig. 48) about 525 μm long, subparallel-sided; penis reaching slightly beyond paramere, dilated at basal $\frac{1}{3}$ and becoming thinner toward apex in dorsal view. Ventral sac shorter than parameres. Parameres close to each other dorsally at basal $\frac{1}{6}$ and thence gradually diverging toward apex; ventral margins characteristically sinuous in lateral view.

Variation.—Two patterns of pronotal granulation have been mentioned above. The lustre, surface of pronotum, and pubescence on elytra usually vary greatly, especially when comparing teneral adults with older ones.

Type series.—Holotype δ (NMNS): "TAIWAN: Ilan County, Chiduan (alt. 1200 m), 2.II.1992, Jeng M. L. leg.". Paratypes (CSUS, DEI, NMW, NTU, OMNH, TARI, NWU): 5 δ and 12 f , same data as of holotype; 14 δ and 12 f , same locality and collector, 29.III.1991; 15 δ and 11 f , type locality, 2.XI.1996; 5 δ and 5 f , type locality, 26.VI.1992, Lee C. F. leg.; Ilan County, Mt. Taiping (alt. 2000 m), 8.VIII.1991; 1 δ and 1 f , same locality, 11.VIII.1990, Chang S. J. leg.; 2 f , Ilan County, Nan-ao: Shenmi Lake (Mysterious Lake), 5.VI.1993 (alt. 1200m); 1 δ and 1 f , Nantou County, Dongpu: Yunlong Fall (alt. 1600m), 13.VI.1992; 2 f , Nantou County, Dongpu: Lerler (alt. 1250m), 1.II.1993; 1 δ , Taichung County, Wuling (alt. 1900 m), 1.I.1988, Wong K. C. leg.; 1 δ , Hualien County, Lien-hwa Chi (alt. 1200 m), 5.IX.1988, Tseng J. S. leg.

Additional material examined.—1 f , Taichung County, Wuling, 18.VIII.1987, Wong K. C. leg.; 1 f , same locality and collector, 9.IX.1987; 1 f , Nantou County, Dongpu: Yunlong Fall, 19.III.1989; 4 δ and 1 f , type locality, 29.III.1991 (NTU).

Differential diagnosis.—In Nomura's key, this species will go to *G. nitidus* Nomura at couplet 3 due to its smooth and shining pronotum. However *G. montanus* is characterized by its distinct pronotal granulation pattern and male genitalia. Male genitalia of *G. nitidus* (Fig. 54) are much

larger than those of *G. montanus* (ca. 670 μm vs. 525 μm), and the parameres of the latter are also distinctive in shape. This new species also resembles *G. hygropetricus* from Taiwan, especially old adults. They can be distinguished from each other by their body size and shape of male genitalia as described in the key.

Distribution.—This species is distributed in higher montane areas (about 1000–2000 m) in northeastern and central Taiwan. Occasionally we found this species and *G. babai* coexisting in creeks at 1000–1200 m. In such a case, one or the other species is much more abundant. All habitats are unpolluted.

Etymology.—The specific name *montanus* (Latin, montane) is in reference to its distribution in montane creeks and streams.

Grouvellinus hygropetricus Jeng and Yang, new species

(Figs. 5, 6, 13, 21, 31, 40, 49)

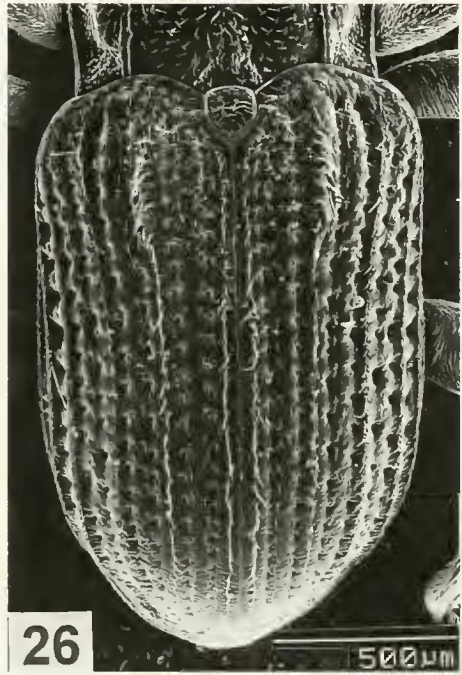
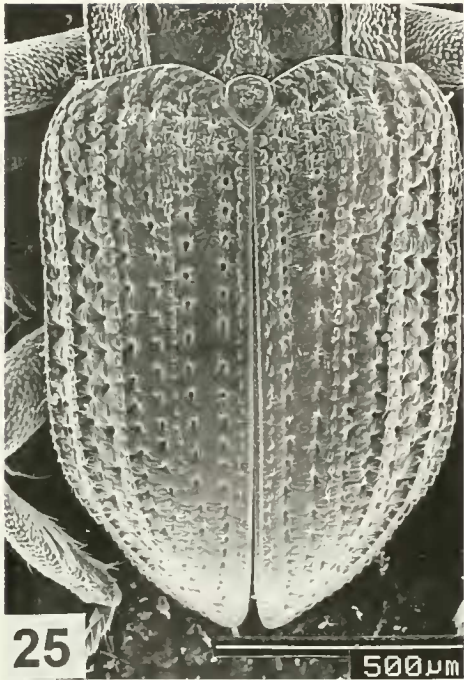
Type locality.—Wulai, Taipei County, northern Taiwan.

Description.—BL: 2.3–2.6 mm (male), 2.5–2.7 mm (female); BW: 1.0–1.2 mm (both sexes).

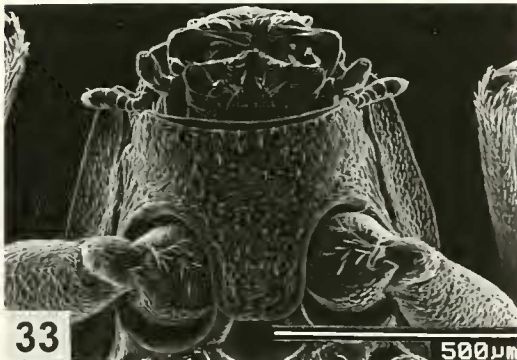
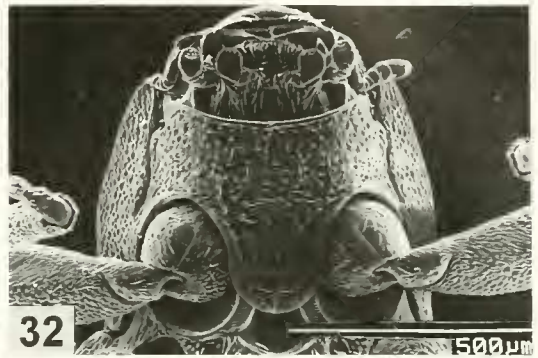
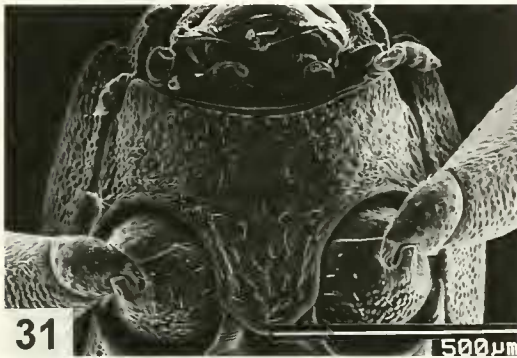
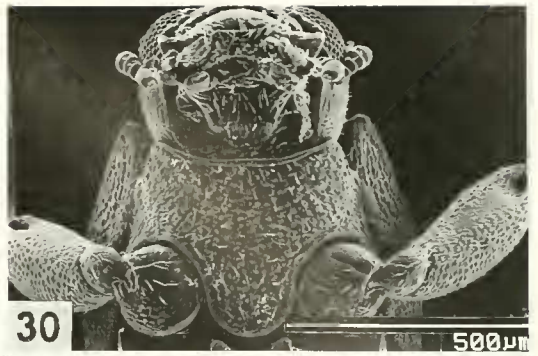
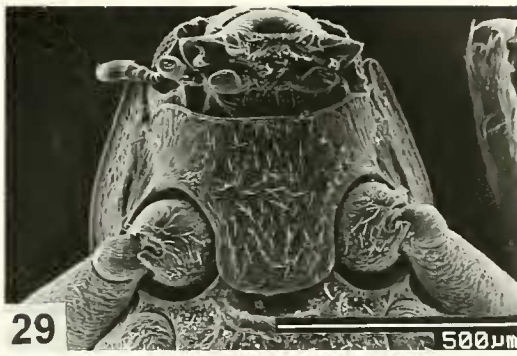
Body shape elongate obovate, subparallel. Dorsum shining, dark brown to black; old adults may lose lustre and look opaque. Venter and legs reddish brown. Antenna, mouthparts and tarsi yellowish brown.

Head coriaceous, superficially granulate. Vertex, lateral sides of clypeus and anteriolateral sides of labrum with long pubescence, but more sparse on vertex than on the rest. Clypeus coriaceous. Labrum smooth, weakly and sparsely punctate.

Pronotum (Figs. 5–6) evenly convex, 1.1 times broader than long, broadest point just behind middle. Surface of the disc smooth and shining in apical half, with conspicuous granulation; granules separated from each other by 1–3 times their diameters; basal half of the disc slightly coriaceous, particularly pronounced in median area (Fig. 13); sublateral areas coarsely granulate. Sublateral carinae present in basal $\frac{2}{5}$; an oblique



Figs. 25–28. 25, *Grouvellinus subopacus*, male elytra. 26, *G. nitidus*, male elytra. 27, *G. subopacus*, male habitus. 28, *G. babai satoi*, male habitus.



Figs. 29–34. Prosternum. 29, *Grouvellinus pilosus*. 30, *G. montanus*. 31, *G. hygropetricus*. 32–33, *G. babai*. 34, *G. marginatus*.

impression on each side extending from apex of carina to near anterior angle. Each sublateral gibbosity slightly convex and coarsely granulate. Base with two shallow impressions just before scutellum.

Elytra (Fig. 21) 1.2 times broader than pronotum, 1.7 times longer than broad, with conspicuous sexual dimorphism (elytral apex more acute in female but conjointly rounded in male); weakly serrate along lateral margin. First stria quite narrow, with

punctures small and shallow; punctures of other striae larger and deeper on disc but becoming finer and shallower on apical declivity. Strial interval with surface transversely rugose; each interval with a row of granules; First two intervals flat; interval 3 moderately convex and a little broader at base; pubescent tuft on base of third interval present or entirely absent; intervals 5, 7 and 8 moderately carinate. Prosternum (Fig. 31) with prosternal process weakly rimmed.

transversely convex at base and broadly rounded at apex. Metasternum coarsely and densely granulate, with disc broadly depressed in male but flat and weakly concave in female. Abdomen (Fig. 40) with all ventrites granulate throughout; granules on central area much more sparse than on sublateral areas.

Male genitalia (Fig. 49) about 780 μm long. Penis weakly dilated at basal $\frac{1}{3}$, and slightly blunt at apex; parameres almost contiguous dorsally, with ventral margin almost straight in lateral view; paramere about 1.5 times longer than basal piece. Male genitalia of this species are the largest among species from Taiwan and Japan.

Variation.—The coloration, lustre, pronotal granulation, and density of setae on the dorsum are highly variable among individuals of different ages (cf. Figs. 5 and 6).

Type series.—Holotype δ (NMNS): "TAIWAN: Taipei County, Wulai (alt. 150 m), 8.IX.1993, Jeng M. L. leg." Paratypes (CSUS, DEI, NMW, NTU, OMNH, TARI, NWU): 6 δ and 13 f , identical data with holotype; 13 δ and 8 f , same habitat, 16.IX.1993; 1 f , type locality, 12.IX.1992, Lee C. F. leg.; 4 δ and 3 f , Taoyuan County, Shuenyuen (alt. 1000 m), 18.III.1996, Wang L. J. leg.; 1 δ , Hwalien County, Yuli: Nan-an Fall (alt. 210m), 27.III.1993.

Additional material examined.—6, Taipei City, Neishuangshi: Sant Fall, 3.IV.1991; 4, type locality, 8.IX.1993; 6, type locality, 16.IX.1993; 1, Taipei City, Shihlin: Pingdengli, 8.VI.1997 (NTU).

Differential diagnosis.—This species is somewhat similar to the preceding species in coloration, lustre, pronotal granulation, and elytral striae and intervals. *Grouvellinus hygropetricus* differs from the preceding species by its larger body size, pronotal surface which is smooth in apical half but coriaceous in basal half, reddish-brown femora and tibiae, and distinctive male genitalia. *Grouvellinus subopacus* also has reddish-brown legs, but it is much smaller (1.6–1.8 mm) than this species and its body form is more stout.

Distribution.—Taiwan. The habitats at Neishuangshi, Shuenyuen and Wulai (type locality) are similar: a steep rock wall with seepage water (hygropetric habitat). A lot of dehydrated individuals were found dead on the rocks due to a severe drought when we collected this species at the type locality. Living adults refuged in small pits or cracks of rocks with a little water flow and moist mosses. At another locality, Nan-an Fall, widely separated from the other localities, one specimen was collected from benthos of a stream. It is still not clear at present whether this species is continuously distributed from northern to southeastern Taiwan.

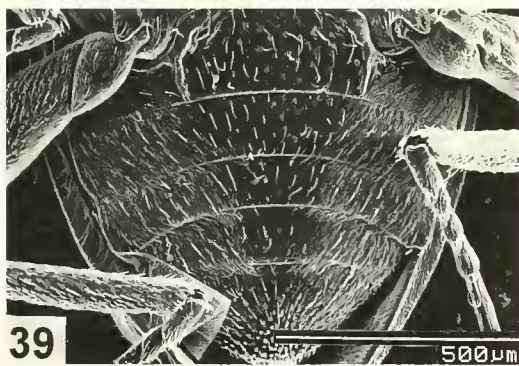
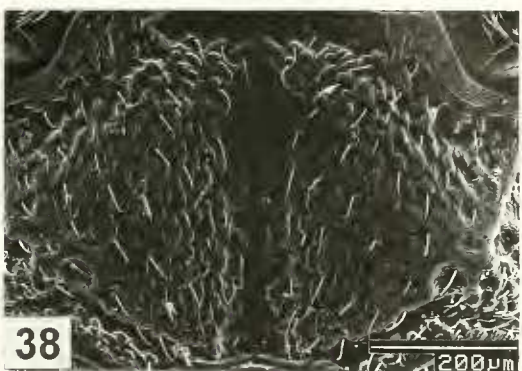
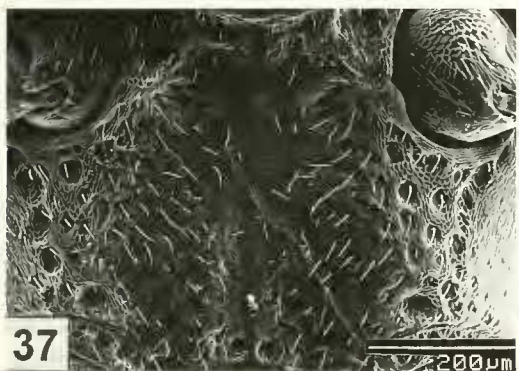
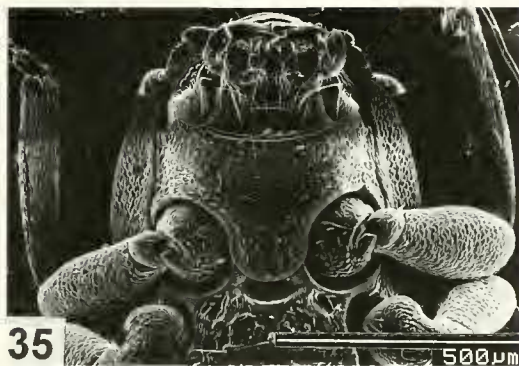
Etymology.—The specific name is derived from *hygro-* (wet) and *-petricus* (pertaining to rocks (Latin)), referring to its unusual microhabitat (seepage water on rocks), which differs from that of all the other *Grouvellinus* species from Taiwan and Japan.

Grouvellinus babai babai Nomura
(Figs. 7, 14, 22, 32, 33, 38, 41, 50)

Grouvellinus babai Nomura 1963: 54.

Type locality.—Near Mt. Neng-Gao, Nantou County, central Taiwan.

Redescription.—BL: 1.8–2.3 mm, BW: 0.9–1.0 mm. Dorsal surface brown to dark brown, with weak bronze lustre. Pronotum (Fig. 7) evenly convex, with surface shagreened and moderately pubescent (Fig. 14); sublateral carinae present; granulation on each sublateral gibbosity similar to that on disc. Elytra (Fig. 22) with conspicuous sexual dimorphism (elytral apex more acute in female but conjointly rounded in male); punctural striae deeply notched; striae intervals 1–4 transversely rugose, each with 1–2 rows of pubescence; interval 3 feebly convex basally, with or without pubescent tuft; intervals 5, 7 and 8 carinate, striae interval 8 partially concealing interval 9 in dorsal view. Prosternal process (Figs. 32–33) about $\frac{1}{4}$ as broad as pronotum, with apex round or truncate. Metasternum (Fig.



Figs. 35–40. 35, *Grouvellinus subopacus*, prosternum. 36, *G. nitidus*, prosternum. 37, *G. pilosus*, male metasternum. 38, *G. babai babai*, male metasternum. 39, *G. pilosus*, abdominal ventrites. 40, *G. hygropetricus*, abdominal ventrites.

37) coarsely shagreened. Abdomen (Fig. 41) with each ventrite densely granulate throughout. Male genitalia (Fig. 50) about 440 μm long; penis conspicuously dilated at basal $\frac{2}{5}$ in dorsal view; paramere about 1.4 times as long as basal piece, slightly sinuate dorsally.

Differential diagnosis.—This species is most closely related to *G. marginatus*

(Kôno) from Japan. According to Nomura's key (1963), they can be distinguished from each other by their lustre, body size and the elevation and pubescence of elytral stria interval 3 (cf. Figs. 9, 24). Generally it is true that *G. babai* is less shining than *G. marginatus*; however, this character does not apply to old and extremely eroded specimens. The other characters are quite vari-

able in *G. babai*. Valuable and reliable taxonomic characters are in the male genitalia. Male genitalia of *G. babai* are smaller than those of *G. marginatus*; the parameres are wide and short in *G. babai*, but slender and long in *G. marginatus*; the penis of the former has the lateral sides conspicuously sinuous in dorsal view while the latter has them gradually tapering toward apex. A similar situation is also found in *G. caucasicus* vs. *G. rioloides* (cf. Jäch 1990).

Morphologically both *G. babai* and *G. marginatus* can be grouped with *G. caucasicus* (Motschulsky), *G. rioloides* (Reitter), *G. duplaris* Champion and *G. brevior* Jäch by their similar male genitalia and pronotal surface (cf. Jäch 1984, 1990). However a thorough investigation of their synapomorphic characters and phylogenetic relationships is necessary.

Type material.—Holotype ♂ (NSMT): "Nankoson, M. Formosa, 22. Nov. 1962, leg. K. Baba/HOLOTYPE, *Grouvellinus babai* Nomura (1963)"; 2 paratypes, with the same data as holotype (NWU). The remaining paratypes are to be deposited in NSMT, NWU and also possibly in Dr. K. Baba's collection. Besides type material, 416 adults from many localities of Taiwan were also examined.

Distribution.—Widely distributed throughout Taiwan from lowland through montane areas at about 1200 m. They prefer microhabitats with cobbles or rocks encrusted with algae in fast water. Occasionally they can be found in somewhat polluted streams.

Grouvellinus babai satoi, Jeng and Yang, new subspecies

(Figs. 8, 15, 23, 28, 42, 51)

Type locality.—Hakusui-Ke, Takeda, Is. Ishikagi, Japan.

Type series.—Holotype male (NWU), "JAPAN: Is. Ishikagi, Takeda: Hakusui-ke, 17.VIII.1996, M. L. Jeng leg.". Paratypes (CSUS, NMW, NTU, TARI, NWU): 22 ♂ and 24 ♀, same data with holotype; 5 ♂ and 11 ♀, Is. Iriomote, Nishifunatsuki-gawa, 18.VII.1996, M. Satô leg.; 1 ♂ and

4 ♀, Is. Iriomote, Nishifunatsuki-gawa, 29.X.1997, M. Kimura leg.; 1 ♂ and 2 ♀, Is. Iriomote, Kampirei, 23.III.1995, M. Satô leg.; 1 ♂ and 1 ♀, Is. Iriomote, Kampirei, 19.VII.1996, M. Satô leg.

Differential diagnosis.—BL: 1.5–1.7 mm (male), 1.6–1.8 mm (female); BW: 0.7–0.8 mm (both sexes); male genitalia about 340 μ m long. This new subspecies is very similar to the nominotypical subspecies from Taiwan except for its much smaller body size and male genitalia (Fig. 51) which do not overlap quantitatively with those of *G. babai babai*. The ventral margin of the paramere is sinuate laterally in *G. babai satoi* but nearly straight in *G. babai babai*. Furthermore, they can be separated from each other by the pronotal surface which is very finely punctate (Figs. 8, 15) in *G. babai satoi* but shagreened in populations of *G. babai babai*. Generally the granulation of the abdominal ventrites of *G. babai satoi* (Fig. 42) is sparser than in *G. babai babai*.

Distribution.—Is. Ishikagi and Is. Iriomote of Japan.

Etymology.—Named for Dr. M. Satô who has immensely contributed to the taxonomy of the water beetles of Japan and the adjacent areas.

Grouvellinus marginatus (Kôno)

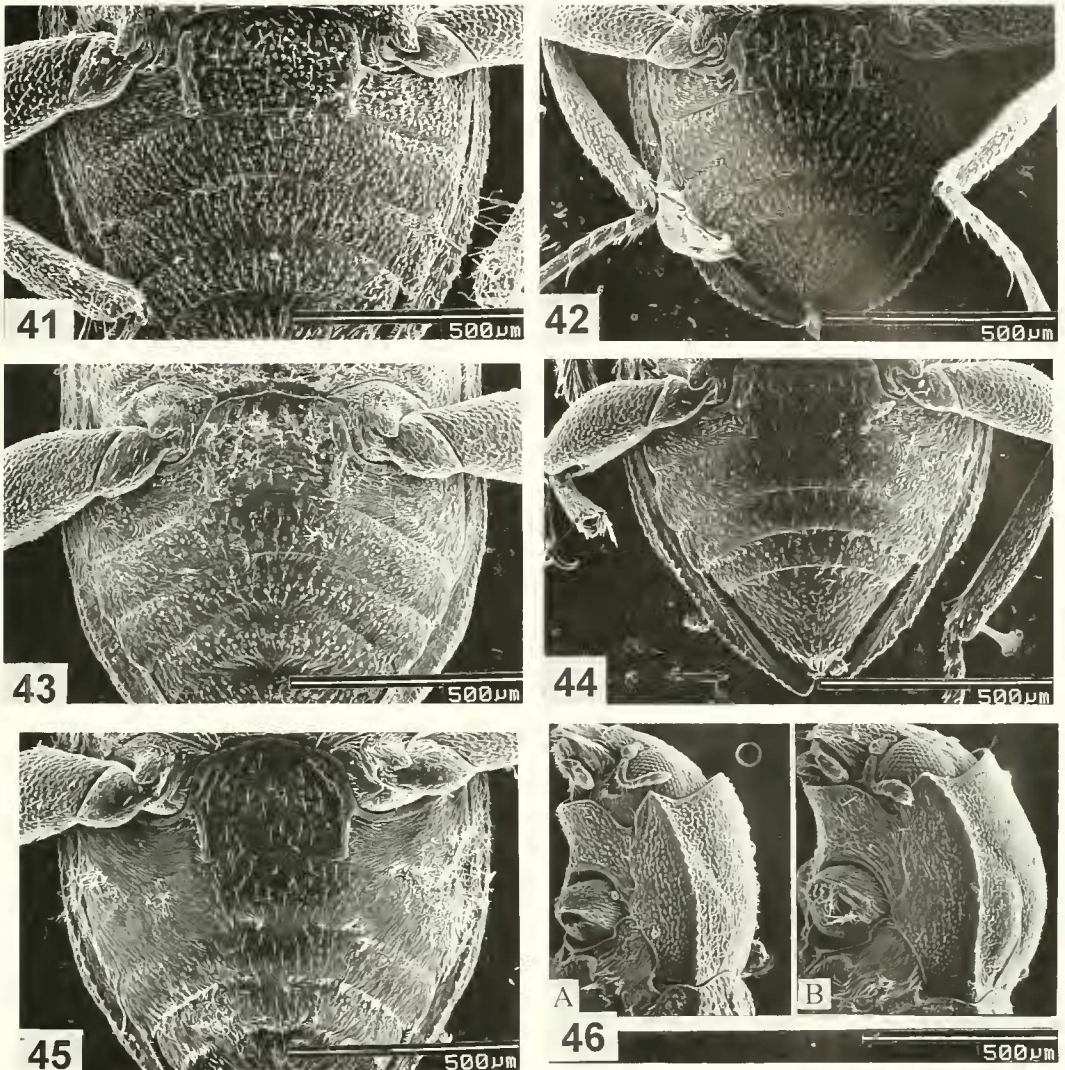
(Figs. 9, 16, 24, 34, 43, 52)

Grouvelleus marginatus Kôno 1934:127.

Grouvellinus marginatus (Kôno): Nomura 1957: 44; 1960:36; 1963: 52; Satô 1965: 83; 1977: 4; 1985: 438.

Type locality.—Koyadaira, Awa, Shikoku, Japan.

Redescription.—BL: 2.2–2.5 mm, BW: 1.0–1.1 mm. Dorsal surface brown to dark brown, with bronze lustre. Pronotum (Fig. 9) subquadrate or slightly broader than long; evenly convex, with shagreened surface (Fig. 16) similar to *G. babai*; sublateral carinae present; surfaces of each sublateral gibbosity identical to that of the disc. Elytra (Fig. 24) with conspicuous sexual dimorphism (elytral apex more acute in female



Figs. 41–46. 41, *Grouvellinus babai babai*, abdominal ventrites. 42, *G. babai satoi*, abdominal ventrites. 43, *G. marginatus*, abdominal ventrites. 44, *G. subopacus*, abdominal ventrites. 45, *G. nitidus*, abdominal ventrites. 46A, *G. montanus*, evenly convex pronotum. 46B, *G. nitidus*, strongly convex pronotum.

but conjointly rounded in male); postero-lateral margin very weakly crenate; punctural striae deeply notched; surface of striae intervals 1–4 transversely rugose; the 3rd interval broadly elevated at base where it bears a tuft of golden pubescence; interval 5 granulate; intervals 7 and 8 carinate; interval 9 partially concealed by interval 8 in dorsal view. Prosternal process (Fig. 34) about as broad as $\frac{1}{2}$ width of the pronotum, with apex rounded. Metasternum coarsely

shagreened. Abdominal ventrites I–V (Fig. 43) with surface moderately granulate. Male genitalia (Fig. 52) about 500 μm long; paramere elongate and slender, 1.9 times longer than basal piece; penis gradually tapering toward apex, and slightly sinuate near apex.

Type material.—Lectotype δ (here designated, DE1), “Shikoku: Awa, Koyadaira: Japon: 31-7-13 Edme Gallois\Syntypus*Grouvelleus marginatus* Kôno det. H.

Kôno\DEI Eberswalde\Microdes marginatus Kono\LECTOTYPE *Grouvellinus marginatus* (Kôno) des. Jeng and Yang 1997." One male and a female paralectotypes with the same data as holotype (DEI); 2 paralectotype females, "Shikoku: Awa, Koyadaira: Japon: 29-7-13\Paratype *Grouvellinus marginatus* Kôno" (handwriting, NWU). The depository of the remaining paralectotypes, neither in NSMT nor in Hokkaido University, is unknown.

Material examined.—1, Okube, Mie Pref., 28.XI.1965, M. Satô; 2, Nr. Nisumi, Shimane Pref., 27.VII. 1979, T. Shimomura; 1, Ozegahara, Gumma Pref., Aug. 20–24, 1979, M. Satô leg.; 1, Sai-kawa, Ishikawa Pref., 27.V.1976, R. Ohgushi (NWU and NTU); 4, "Japan, Sakaguchi\Kishu (in Chinese), VI. 1931\Grouvellinus marginatus Kono, 1934, det. H. Kono" (NSMT, examined by K. Mizota).

There were sixty-six specimens denoted by Kôno as "types," but no holotype was mentioned in the original description. Gaedike (1985) indicated that there are 3 syntypes deposited in DEI. It is interesting that the type material from NWU bears handwritten "paratype" labels. It is possible that Kôno had labeled a "holotype" from the type series by himself.

Differential diagnosis.—This species is quite similar to *G. babai*. The most reliable characters to separate them are in the male genitalia which have been described above.

Distribution.—Japan (Honshu, Shikoku, Kyushu, Yaku-shima).

Grouvellinus subopacus Nomura
(Figs. 10, 17, 25, 27, 35, 44, 53)

Grouvellinus subopacus Nomura 1962: 48; 1963: 52; Satô 1964: 5; 1965: 83; 1977: 5; 1985: 438.

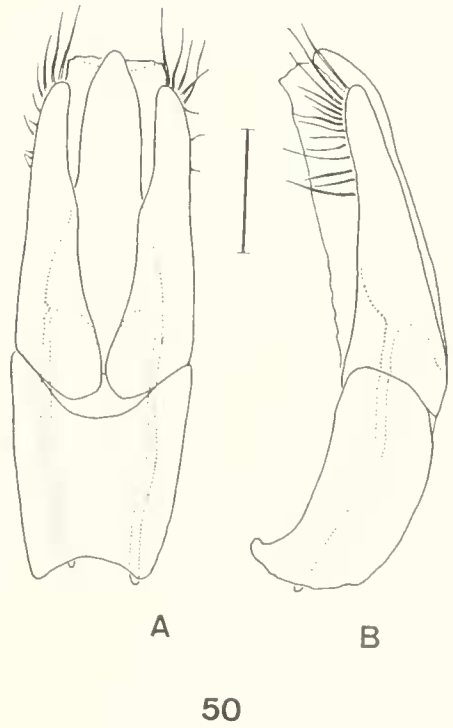
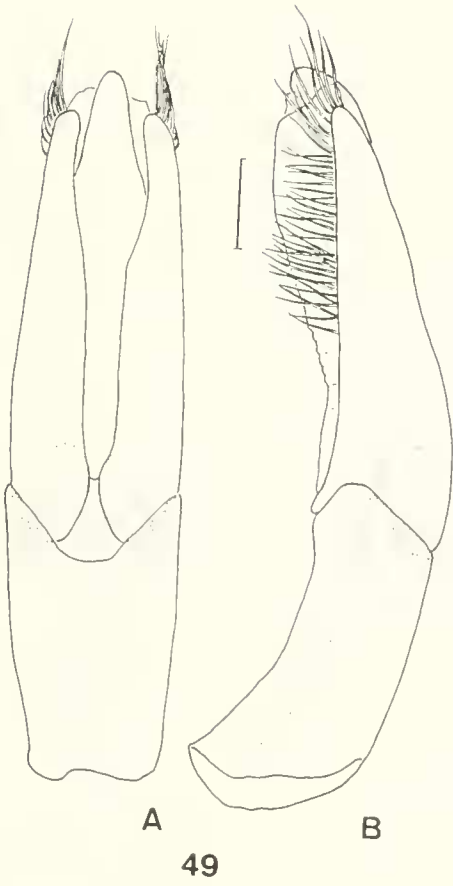
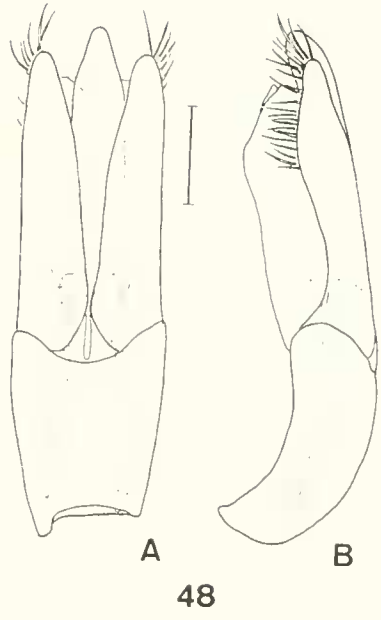
Type locality.—Taken, Amami-Ôshima, Japan.

Redescription.—BL: 1.6–1.8 mm, BW: 0.7–0.9 mm. Dorsal surface dark brown, with very weak lustre; femur and tibia reddish brown. Pronotum (Fig. 10) evenly convex; surface (Fig. 17) densely and superficially punctate, very similar to that of *G. babai satoi*; sublateral carinae present; each sublateral gibbosity with surface coarsely granulate. Elytra (Fig. 25) comparatively wide, EL/EW about 1.3–1.4; elytral apex of female somewhat broadly rounded, but still acute than that of male; posterolateral margin serrate; punctate striae deeply notched, stria 6 with punctures separated from each other longitudinally by a noticeable granule; striae intervals 1–2 broad and flat, with surface irregularly rugose; interval 3 weakly convex basally, without pubescent tuft on base but with a row of superficial granules along interval; interval 5 similar to 7, composed of a noticeable granulate row; striae interval 9 entirely concealed by interval 8 from dorsal view. Prosternal process (Fig. 35) about $\frac{1}{4}$ as wide as pronotum, with apex broadly rounded. Abdominal ventrites (Fig. 44) with central disc nearly bare and sparsely granulate but sublateral areas thickly covered with plastron and densely granulate. Tarsus usually shorter than tibia in middle and hind legs. Male genitalia (Fig. 53) about 430 μ m long; penis surpassing parameres, dilated at basal $\frac{1}{3}$ and gradually tapering toward apex in dorsal view; parameres slender and elongate, 1.6 times longer than basal piece, with ventral margin nearly straight in lateral view.

Material examined.—2, (Ryukyus), Yona, Okinawa, 13 VIII 1969, Y. Hori leg.; 1, Is. Okinawa, Kunigami, Tima-gawa, 22.VII.1996; 1, Is. Okinawa, Kunigami, Hiji-gawa, 21.VII.1996; 4, Is. Okinawa, Ohgimi, Taiho-gawa, 21. VII. 1996. The holotype female was not examined; it is possibly deposited in NSMT.

→

Figs. 47–50. Male genitalia; A = dorsal aspect, B = lateral aspect. 47, *Grouvellinus pilosus*, paratype from type locality. 48, *G. montanus*, paratype from type locality. 49, *G. hygropetricus*, paratype from type locality. 50, *G. babai babai*, specimen from Ilan County.



Differential diagnosis.—This species is characterized by its small and broad body, densely punctate surface of the pronotum, granulation of elytral stria 6 and strial interval 3, and its male genitalia. Furthermore it is the smallest species possessing the sub-lateral carina of the pronotum and the elevated strial interval 5 of elytra. *Grouvellinus babai satoi* possesses many features similar to *G. subopacus*, but they can be easily distinguished from each other by their body form (Figs. 27 vs. 28) and the male genitalia.

Nomura (1962, 1963) stated that the first four strial intervals of the elytra of this species are flat, and denoted it as one of the key characters to distinguish it from other congeners from Japan and Taiwan. However, all material from Okinawa we examined do have their interval 3 more or less convex basally; it is possibly a geographic variation. In addition, Nomura also described that the tarsus is shorter than the tibia in this species. It is generally true that this character is stable in this species, but it is not a useful feature due to its instability in other species.

The phylogenetic affinity of *G. subopacus* is still in question. Although this species looks very different from *G. babai satoi* in body shape and male genitalia, it is interesting that the pronotal surface and the structure of elytral stria 6 is similar to that of *G. babai satoi*. Whether these characters possess phylogenetic value needs more thorough investigation.

Distribution.—Japan (Amami-Ôshima, Tokuno-shima, Is. Okinawa).

Grouvellinus nitidus Nomura
(Figs. 11, 18, 26, 36, 45, 46B, 54)

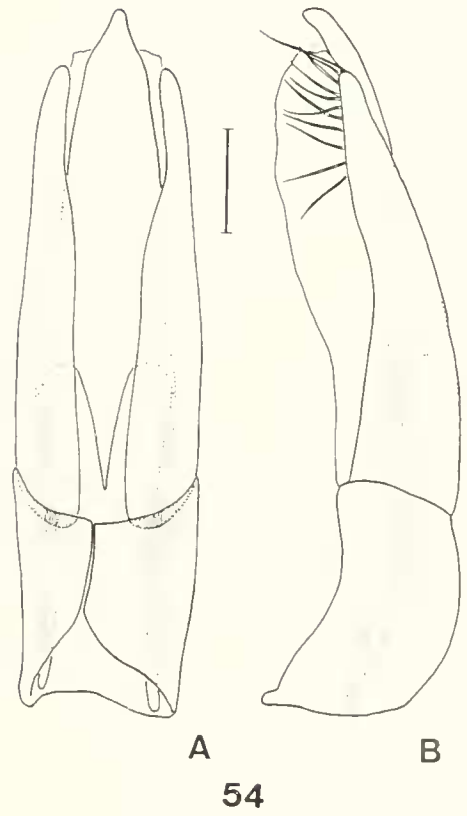
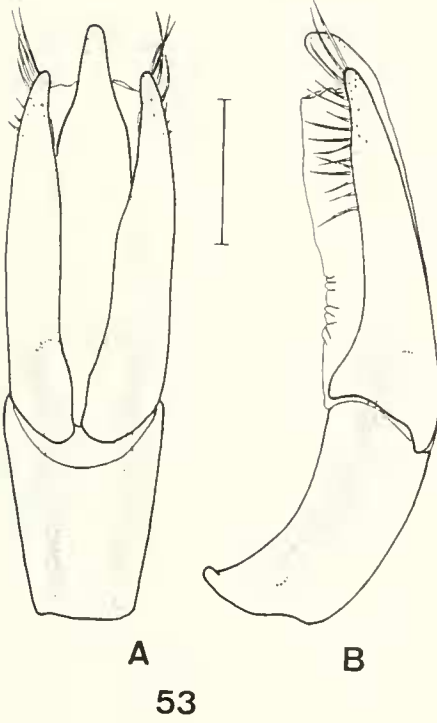
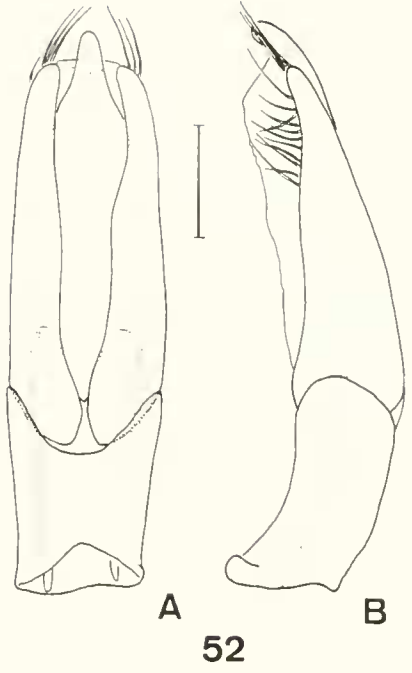
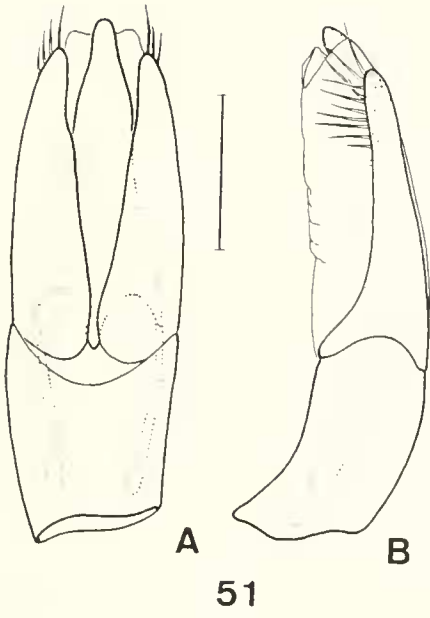
Grouvellinus nitidus Nomura 1963: 52;
Satô 1977: 4; 1985: 438.

Type locality.—Ryûzu, Nikko, Honshu, Japan.

Redescription.—BL: 2.1–2.3 mm, BW: 1.0–1.1 mm. Dorsum dark brown with strong lustre. Pronotum (Fig. 46B) strongly convex at basal $\frac{2}{5}$; surface (Figs. 11, 18) smooth and shining, sparsely granulate; sublateral carinae present; each sublateral gibbosity weakly and sparsely punctate. Elytra (Fig. 26) with conspicuous sexual dimorphism (elytral apex more acute in female but conjointly rounded in male); striae deeply notched; intervals weakly wrinkled; interval 3 broadly and distinctly elevated at base and usually with a tuft of pubescence in young adults; interval 5 with a row of granules; intervals 7–8 carinate. Prosternal process (Fig. 36) a little narrower than $\frac{1}{4}$ pronotal width, with apex rounded. Abdominal ventrites (Fig. 45) sparsely granulate on central disc but becoming denser on sublateral areas; plastron present on sublateral sides of each ventrite and apical areas of ventrites II–V, but absent on discs. Male genitalia (Fig. 54) about 670 μ m long, general appearance quite similar to those of *G. hygropetricus*, but a little smaller; penis broadest at basal $\frac{1}{4}$ and thence gradually tapering toward apex in dorsal view, apical part slender in lateral view; parameres long and slender, widely separated dorsally, with ventral margin weakly sinuous in lateral view; paramere about 1.9 times as long as basal piece.

Variation.—The pubescence pattern of the elytra is very variable. According to Nomura's (1963) key, the pubescence on intervals 1 and 3 is fine and indistinct; but this is in contrast to the individual shown in Fig. 26 of which pubescent tuft is dense and distinct.

Type material.—Paratypes: 5: "Mamogawa-toge, Niigata Pref., 9. VIII.1961, M.



Satô leg. PARATYPE *Grouvellinus nitidus* Nomura (1963)" (NWU and NTU). The holotype male was not examined; it is deposited in NSMT; the remaining paratypes are in NSMT and NWU.

Differential diagnosis.—This species resembles *G. montanus* from Taiwan in the smooth surface and granulation pattern of the pronotum. It can be distinguished from *G. montanus* by its distinctive shape, the larger size of the male genitalia, and the scarcely granulate surface of the sublateral gibbosity of the pronotum. The male genitalia of this species is also somewhat similar to that of *G. hygropetricus*. The basal piece of *G. nitidus* is comparatively short while that of *G. hygropetricus* is long. In addition, they can be separated from each other by the surface of the pronotal gibbosity which is smoother in *G. nitidus* but roughly granulate in *G. hygropetricus*.

Distribution.—Japan (Honshu).

ACKNOWLEDGMENTS

Sincere thanks are due to Dr. M. Satô (NWU), Dr. M. A. Jäch (NMW) and Dr. L. Zerche (DEI) for sending us specimens for investigation. We are also obliged to Dr. M. A. Jäch, Mr. D. S. Boukal (Czech Academy of Science), Dr. H. P. Brown (OMNH) and Dr. W. D. Shepard (CSUS) for reading the manuscript. Mr. K. Mizota (Hokkaido University) helped check specimens in NSMT; Miss Shao-Shi Jen, Mrs. Jin-Yen Lin and Mr. Ji-Yuan Tang assisted in taking SEM micrographs. This study was financially supported by the National Science Council, grant no. NSC86-2313-B002-079.

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